PLATE XXIV.

Fig. 1. *Aspidophyllum Huxleyanum*, Thoms., transverse section, enlarged; 1 A, transverse section of the same, natural size. Lower Carboniferous, Thirdpart, Beith, Ayrshire.

Fig. 2. *Aspidophyllum*, sp., transverse section. Lower Carboniferous, Gateside, Beith, Ayrshire.

Fig. 3. *Dibunophyllum Muirheadi*, Nich. & Thoms., transverse section; 3 A, longitudinal section of the same. Lower Carboniferous, Gateside, Beith, Ayrshire.

Fig. 4. *Dibunophyllum*, sp., view of the interior of the calice, showing the arrangement of the ridges formed by the free edges of the vertical lamellæ of the central area; 4 A, transverse section of the same. Lower Carboniferous, Langside, Beith, Ayrshire.

PLATE XXV.

Fig. 1. *Dibunophyllum*, sp., transverse section, showing the mesial lamina which divides the central area; the septa become vesicular and broken up towards the circumference by the great development of the dissepiments. Lower Carboniferous, Langside, Beith, Ayrshire.

Fig. 2. Transverse section of a young form of *Dibunophyllum*; 2 A, external aspect of the same, showing the interior of the calice.

Fig. 3. *Dibunophyllum M'Chesneyi*, Nich. & Thoms., showing the interior of the calice; 3 A, transverse section of the same; 3 B, longitudinal section of the same, showing the unusual fact that there is but a single columellarian line, as in *Clisiophyllum*. Lower Carboniferous, Brockley, Lesmahagow.

Fig. 4. *Dibunophyllum Muirheadi*, Nich. & Thoms., transverse section; 4 A, longitudinal section of the same, showing the normal structure of the genus. Lower Carboniferous, Gateside, Beith, Ayrshire.

Fig. 5. *Dibunophyllum Muirheadi*, Nich. & Thoms. (?), transverse section. Lower Carboniferous.

Fig. 6. *Dibunophyllum*, sp., interior view of the calice; 6 A, transverse section of the same. Lower Carboniferous.

Fig. 7. *Dibunophyllum*, sp., transverse section. Lower Carboniferous.

[To be continued.]

LIV.—*On the Identity in Type of the Annelids and Vertebrates. A preliminary Communication* *. By C. SEMPER.

THE old view of Geoffroy St.-Hilaire and Ampère concerning the agreement in affinities of the Articulates and Vertebrates was, as is well known, completely supplanted by the type theory of Cuvier and Von Baer, which supposed a great difference in the structure of the two groups. And not without good reason; for if the inversion of an Articulate so that its ventrum was

* Translated from the 'Physikalisch-medicinische Verhandlungen zu Würzburg,' by P. Herbert Carpenter, B.A.

directed upwards, which was suggested by Ampère, Joh. Müller, and Rathke, and even earlier by Meckel, led to the recognition of a great agreement with the Vertebrates in the origin and position of many organs, those Articulates which were chosen for comparison (the Insects and Crustacea) were precisely the ones which were not well suited to furnish the proof of the correctness of the original view; for no one had succeeded in demonstrating the existence not only of the above-mentioned resemblances, but also of actual agreement in type of the Articulates and Vertebrates.

The case is now, I think, different; through the discovery of segmental organs in the embryos of the Plagiostomes and in many adult sharks *, I was led to suggest this process of inversion once more—but as applied to an Annelid†, by which was revealed a correspondence between Articulates and Vertebrates far more complete in detail than that obtained by the former direct comparison of Crustacea or of Insects with Vertebrates. Nevertheless there were some difficulties; and it is natural that others should lay stress upon them in order to demonstrate indirectly the unimportance of the extensive resemblances, first pointed out by me, in the typical structure of an Annelid and of a Vertebrate embryo.

The following preliminary communication is intended to

* See 'Annals and Magazine of Natural History,' ser. 4, vol. xv. p. 94.

† I should like to suggest that a slight *lapsus calami* occurred to our revered master Baer when he lately, in his notice of Dohrn's and my works, represented the facts incorrectly: it is not the former who was the first to compare the inverted worm-sections with transverse sections of a Vertebrate embryo, and the organs of both with one another respectively, but I; and this was not done by me incidentally, but completely and with the addition of figures. My first preliminary communication upon this subject appeared in July 1874, and the larger memoir ('Die Stammverwandtschaft' &c.) in October 1874; while Dohrn's work first appeared in February or March 1875.

It must be admitted that this investigator goes further than I in his hypothetical conclusions; thus he loses himself in specialities which cannot be proved and are completely devoid of substantial foundation; while I stop at the proof of the identity in relative position of almost all the organs of the Annelids and of the vertebrate embryos. But this I must claim as my property, to the acquisition of which no earlier expression of Dohrn could have led me; while it remains doubtful whether Dohrn would have taken an annelid as his starting point if he had not been acquainted with my work before publishing his own. It is true that he claims (*l. c.* p. iv) to have intimated, in the preface to the second part of his paper on the structure and development of the Arthropods, that "to him it was not so much the Ascidians as the Annelids which seemed to be the Invertebrates standing nearest to the Vertebrates." In the preface to the second part, however, there is no mention of this, and just as little in his other articles on the Crustacea. In the introduction to the third part (Jenaische Zeitschr. Band v. p. 278), where he first treats of

show that I have succeeded in the most surprising manner in demonstrating that all those difficulties either do not exist or else prove nothing, and at the same time in finding out such extraordinarily extensive resemblances, both in the type of the three classes of segmented animals and also in all their special relations, that he only, in my opinion, is justified in rejecting my views who believes himself able to arrive at morphological laws through physiological relations.

The opponents of my views do not agree in essential points. On the one hand Baer says:—(1) ventrum and dorsum are homologous in Vertebrates and Articulates; (2) therefore this is not the case with the ventral cord and spinal cord, for the latter has a dorsal and the former a ventral position; (3) the Articulates have no brain in the sense that the Vertebrates have, for their dorsal œsophageal ganglion is only the anterior end of their ventral ganglionic cord; and (4) the Articulates have only a singly symmetrical development, but the Vertebrates a doubly symmetrical one. On the other hand, Gegenbaur tacitly presupposes certain points, such as the distinction in type, to be proved; the arguments brought forward by him against my views are as follows:—(1) the position of the ventral cord (in agreement with Baer); (2) the dorsal position of the supraœsophageal ganglion, which is comparable to the brain and spinal cord of Vertebrates (at variance with Baer); (3) the asserted connexion of the sense-organs with the dorsal œsophageal ganglion in the Articulates; and (4) the dorsal origin of the latter out of a dorsally placed medullary plate.

I will begin with Gegenbaur's arguments. The sense-organs (eyes and ears) are very frequently connected with the ventral ganglia in Crustacea, Insects, and Annelids; the third argument of Gegenbaur is simply incorrect. The second, the

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the old attempt to parallel the shell-gland of the *Daphniæ* with the segmental organs of the worms, he says, "from this it might possibly be attempted to derive the Arthropoda, or at least the Crustacea, from the worms."

Here, then, is no mention of the Vertebrates and Ascidians. If Dr. Dohrn would show me the place where he published the former of the two propositions quoted above before I did, I should be ready to give up to him the honour of having first suggested this idea, and to confess that I had completely overlooked his notification of it.

Among later observers, Leydig and Zaddach are the only ones whom I have to thank for support in the old line of investigation on which I have again recently entered; what, besides their work, has been mentioned by still living older investigators as to the affinities of the segmented animals can be of no use to me, as it contains only repetitions of earlier statements, was never followed up in a consistent manner, and was in great part wrong in its execution.

dorsal position of the supraœsophageal ganglion, is contained, according to our mode of treatment, in the first or fourth. Could it be proved that it originates dorsally and independently of the ventral cord, then its position would be dorsal. Now Gegenbaur asserts in the most decided way that this is proved; but this is only the case in his own imagination.

Not a single observation on the Articulates has been made which really satisfactorily demonstrates that it is formed on the dorsal side; while some, on the other hand, prove very exactly that it takes its origin from the ventral side. Bütschli has shown in the bee, and Ganin still more clearly in the larvæ of Ichneumonidæ, that the anterior end of the first rudiment of the ventral cord divides into two parts, which grow upwards round the œsophagus, and only unite dorsally at a later stage to form the so-called brain. No one mentions the appearance of a separated medullary plate of the dorsum in the Articulates; the frontal plates (*Scheitelplatten*) lie at first on the ventrum, and only gradually reach the dorsum. The assertion of various observers that these arise on the dorsum proves, from their own statements, that they have not understood the first developmental stages.

I can confirm the observations (only made, however, incidentally) of Bütschli and Ganin in the most decided way as regards the Naideæ, in which I have studied the formation of zooids uninterruptedly for six months, with the intention of clearing up the primary origin of the nervous system (ventral cord and brain). I have already gone far enough in this investigation to be able to bring forward the following points as firmly established.

1. The ventral cord originates neither exclusively in the ectoderm (Kowalevsky) nor in the mesoderm (Leuckart, Rathke), but both layers take part in its formation. Only the central azygos ganglion (*Clepsine*) or the azygos cellular cord under the nervous cord (*Lumbricus* &c.) originates directly in the ectoderm; and this is primitively quite unsegmented, precisely as in the osseous fishes. The two lateral ganglia, however, arise out of the protosegments of the mesoderm, and are therefore segmented from before backwards. The first-mentioned central ganglion alone corresponds to the spinal cord of Vertebrates, while the lateral ones correspond to their spinal ganglia.

In agreement with this, the lateral nerves leaving the ganglionic chain arise by two roots; they are true spinal nerves. Herrmann has clearly distinguished these two roots in the leech as superior and inferior.

2. The muscle-plate appears at first not in the neural (ven-

tral) median line, but in a line exactly corresponding to an axis which, in the form of an irregularly cellular cord, lies close beneath (resp. above) the rudiment of the central ganglion. This axis is comparable to the notochord. The muscle-plate bends outwards from it in a cardiac direction (towards the dorsum) round the heart and alimentary canal, and also in a neural (ventral) direction round the central nervous system.

This is the type of the Vertebrates. In *Nais*, just as in them, a cellular cord indicates an axis, from which the animal muscle-plates gradually envelop the alimentary canal on the one side, and on the other the central nervous system developed out of the ectoderm.

3. It is well known that every complete zooid of a chain of Naids is developed by the coalescence of a body part, which first appears, with a later-appearing cephalic part; the latter has usually only four (at most six), but the former from 9–24 segments. In both parts these segments appear according to the laws of annelid-segmentation; the first body-segment is invariably the oldest, and it coalesces with the fourth and youngest cephalic segment. This difference in the formation of cephalic and body-segments is here extremely sharply defined; it appears also in the larvæ of marine Annelids (*Terebella* according to Milne-Edwards), and reminds one of the analogous but less clearly marked condition in the Vertebrates and Arthropods. In both groups several new cephalic segments (which are much younger than many of the body-segments) interpolate themselves between the oldest body-segment and the oldest cephalic segment or segments; in both regions segmentation begins in front and ends behind; so that here, as in the Annelids, the youngest cephalic segment is next to the oldest body-segment.

4. In the cephalic part, the brain of the zooid does not originate in a dorsal medullary plate overlying the alimentary canal, but it is developed by a division of the anterior end of the ventral cord and the upward growth of the two halves of the œsophageal ring around the gullet. In this growth the two lateral ganglia chiefly participate, with, perhaps, a part of the central one (it was not possible to determine this with certainty in the specimens, requiring much difficult treatment, which I have yet examined), and finally also some secondary structures.

There appear, namely (even, as it seems, in the forms without eyes), either laterally or rather towards the ventral side, two sense-plates, which unite with the œsophageal ring before the latter has lost its cellular structure. Possibly (or even probably), therefore, three different cell-groups take part in the for-

mation of the dorsal œsophageal ganglion, viz.:—the central nervous system derived from the ectoderm of the ventral side, and dividing to form the œsophageal ring; the two lateral spinal ganglia growing round the gullet, and so constituting the greatest part of the œsophageal ring; and, thirdly, the two sense-plates growing upwards from both sides towards the œsophageal ring. There is no trace, however, of an azygos thickening of the ectoderm, situated in the median line of the dorsum, in which the so-called brain could originate; this is formed, as is seen, in the most marked contradiction to the authoritative assertion of Gegenbaur, by the coalescence of two primitively completely separated elements, derived from the ventrum. The distinction between the brain and ventral cord of the Articulates is therefore removed.

With the disappearance of this distinction and a reference to the facts, long known but completely ignored by Gegenbaur, that the sense-organs are not connected exclusively with the so-called brain of the Articulates, the arguments of the Heidelberg zoologist fall at once to the ground. The other suggestions that he brings forward against my view are due not to himself, but to Baer.

In Baer's opposition two arguments of different natures are combined. The one, the "evolutio bigemina," which is only typical for the Vertebrates, is purely morphological; the other, the distinction of ventrum and dorsum, is purely physiological, or almost completely so, dependent, namely, upon the relations of the united organism to the ground bearing it, or to the nutriment it seeks.

The purely morphological argument is refuted by the facts stated above; "evolutio bigemina" is also typical for the Annelids. In these also there are two parts of the animal muscular layer one above the other, and separated by an axis as in the Vertebrates; and as in these latter, so in the former, the one surrounds the alimentary canal, and the other the central nervous system. In the Arthropods this type *appears* to be obliterated. I say expressly *appears*; for up to this time the mode of growth of the muscle-plates has never been determined by transverse sections; and so it is quite possible that their development takes place in the same way as in the Annelids.

Further, should any one succeed in demonstrating that, in this group also, two primary blastodermic layers take part in the formation of the ganglionic chain, which is quite possible, the proof of "evolutio bigemina" in the Arthropods would then be furnished, and the desired correspondence with the Vertebrates established.

But even then, of course, only the identity in type of the three segmented classes would be proved, and not, as was formerly supposed, the near relationship of the Arthropods and Vertebrates, which would stand rather in the position of cousinship to one another, while the Annelids would have to be considered as their common ancestors. For only in these last does one find all the relations in the structure of the blastodermic layers as well as in their gradual segmentation, by the more or less partial transformation of which the typical single segments of the Vertebrates and of the Arthropods are to be explained.

If, therefore, only the relative positions of the organs are taken into consideration, the correspondence in type between the three segmented classes is to be regarded as proved. The result is otherwise, however, if one employs the purely physiological consideration of the position with regard to the earth's surface in order, as Baer has again recently done, to demonstrate the identity of ventrum or dorsum in all bilaterally symmetrical animals. Then, of course, there appears an absolute distinction between Articulates and Vertebrates; what in the latter is turned upwards, lies in the former on the ventrum; and a similar direct inversion appears in all the organs, although "evolutio bigemina" is typical in both cases.

But how is the identity of the ventrum* in the Articulates and the Vertebrates demonstrated? I have sought in vain to find a proof of it in Baer's latest work. It could only be established in one of two ways—either by proving that the same organs lie on the ventral side in both groups of animals, which is in this case impossible, or by showing that (perhaps in consequence of the influence of gravity upon the developing

* I should like in this place to be allowed to make a second small correction in Baer's reproduction of my remarks. Baer says that I had commenced my reasoning with the proposition that "dorsum and ventrum are not morphological ideas" in order to smooth my way. This is not quite accurate; for in the complete work, which appeared in October 1874, I introduced this in the course of the discussion of the other arguments against my views, and I did it purposely in order to avoid the appearance of wishing to smooth my way by a dogma; and, further, I did not put the proposition forward as a dogma, but attempted to prove it by the use of various arguments. It may be doubted whether this attempt has succeeded; but no one is justified in ascribing to me an intention of establishing a foundation for discussion which cannot be found in the wording of my paper.

I must confess that this misinterpretation of my words (which, I repeat, is in no way justified) has pained me; or has Baer possibly not read my 'Stammverwandtschaft'? Besides, Baer has completely misunderstood me when he supposes that I wished to deny the existence of a marked morphological distinction between dorsum and ventrum in the same animal or in the same group.

embryo) the ventral side is always directed downwards, and that here therefore dorsum and ventrum are due to mechanical causes, in the same way as the upper and under sides of the leaves of plants.

It is not necessary, however, to commence an investigation in this direction; for a little reflection shows that though in eggs which have been laid, as in the case of the frog and birds, the ventral side in the germinal disk is frequently directed downwards, it must in just as many cases (namely in ovoviviparous animals) undergo constant changes of position; nevertheless no deformities arise, and the type of structure remains unaltered. We cannot therefore speak of a cause acting mechanically which in the different symmetrical animals would always bring the same side downwards. Lastly, it follows from the fact that many animals primitively typically symmetrical, like ourselves and the flat fish, do not have the ventrum directed downwards, that the cause which determines the one or the other side as the ventral side is not dependent upon formative laws acting upon the embryo. The type of development in the various animal forms is independent of the direct influence of their position relatively to the surface of the earth; and it appears to be only the position of the mouth which physiologically determines the ventral side.

I can see, therefore, nothing in the theorem that the ventrum is the same morphological region in all animals, but an unproved and incorrect dogma. Of course, however, this does not necessarily imply what Baer appears to have inferred from my views, that there can be no morphological difference between the ventrum and dorsum in the Vertebrates or in the Articulates; on the contrary, I have accepted this difference just as much as Baer himself. But the existing simple distinction between the two regions does not yet prove that the ventrum is identical in Vertebrates and Articulates; on the contrary, the morphological distinction of the ventrum (or dorsum) in the two classes is proved to me by the perfect identity in the types of their development (evolutio bigemina), and by the almost complete correspondence in the relative positions of nearly all the organs in the two groups to one another (but not in their positions in space).

Baer has of course made use of some morphological arguments, in order to support the proposition that the Articulates have their nervous system on the ventrum of the Vertebrates, and that it is therefore comparable to the sympathetic system of the latter group. He refers first of all to the position of the extremities in the Arthropods; in them, as in the Vertebrates, these are curved towards the ventral side. For this

argument it must be presupposed that the extremities of the Crustacea &c. are homologous with those of the Vertebrates. But this is by no means the case. On the contrary, the Annelids have dorsal appendages which stand in the same relation to their dorsum as the extremities do to the ventrum in the Vertebrates; the dorsum of the former and the ventrum of the latter, however, are, according to my view, identical. In this case, therefore, one would have to compare the extremities of the Vertebrates to the dorsal feet, and the appendages of the Arthropods to the ventral feet of the Annelids.

Baer says further that the ventral side of the Annulates is indicated as such by the ventral position of the anus and genital openings. This, however, is only partially correct. In the segmented Nemertines and in some Annelids the genital apertures are dorsal; in the Nematodes and Myzostomidæ the efferent ducts of the sexual organs unite, as in the Vertebrates, with the rectum; if they lie on the ventral side, they undergo an unusual change in position. This variability in the position of the genital openings shows that it is quite valueless, because it is so extremely uncertain. Further, in many Annelids (the leeches for example) the anus is situated not ventrally but dorsally, and beyond it extends a prolongation of the body (viz. the posterior sucker of the leech), which, in its typical structure and in its origin, may be fairly compared to the tail of the Vertebrates; and one can then designate the posterior ganglion of the leech as caudal ganglion.

The only just argument brought forward by Baer is the ventral position of the mouth in all the Annulates. But it is a question whether the difference of its position in Annelids and Vertebrates may not be satisfactorily explained. Dohrn has made an attempt in this direction which is worth notice, although others may be put by the side of his, for which it is not necessary to enter into such bold speculations as Dohrn is of course obliged to do.

He rightly lays stress on the fact that the unusually late appearance of the Vertebrate mouth is a very remarkable circumstance. In distinction to this is the fact that the mouth appears extremely early in all Annelids, in the free-swimming larvæ of the marine Annelids even earlier than the "Keimstreif." That part of this last, through the segmentation of which the cephalic portion of the worm arises, necessarily finds an obstacle in the already developed gullet, and so curves upwards around it in two divisions. The existence of the gullet as a mechanical obstacle is the essential cause of the formation of the œsophageal ring.

In the Vertebrates, on the other hand, the cephalic portion

of the nervous system is developed extremely early, long before the appearance of the gullet; it finds no obstacle to its growth forwards and above the rudimentary intestine, but space enough to develop, extend, and establish itself. When, then, later the mouth comes to be formed, it cannot break through at the same point as in the Annelids; for the cephalic part of the nervous system here offers far too much resistance, partly through its own nature and partly owing to the rapid development of the embryonic skeleton around it. It is possible that, as Dohrn suggests, the *sinus rhomboideus* indicates the place where such a breaking-through should have occurred, and possible also that the new mouth, now appearing upon the opposite side, is the result of a transformation of the first gill-cleft. These are hypotheses which can scarcely ever be really tested. It is sufficient that Dohrn and I agree that the mouth of the Vertebrates occupies a different position from that of the Annulates. Whether, as I believe, it is a fresh formation on the dorsum of the latter, because the primitive point of perforation is rendered impassable owing to the great development of the brain, or whether it arises directly through the transformation of organs already existing in this position, is of no consequence for the questions immediately before us.

The sole really morphological and effective argument, therefore, which Baer can adduce in support of his opinion, is the position of the mouth, which, however, is not difficult to explain in the manner first suggested by Dohrn. Further, if one reflects that in the type of the Radiates the position of the mouth, as determined by the relation of the animal to the surface supporting it, may be extremely variable, it will scarcely be difficult to conceive it as situated in the one case on the dorsum and in the other on the ventrum.

If one does this, and then inverts the Annelid, a budding *Nais* for example, so that its physiological dorsum lies downwards, there appears an almost absolute identity in the origin and position of the individual organs of the Vertebrates and Annelids. I will here enumerate these points once more, although almost two years ago, and before any one else, I brought some of them prominently forward.

1. The central nervous system is developed unsegmentally from the ectoderm.

2. The spinal ganglia appearing from before backwards, and developed out of the protosegments of the mesoderm, unite with it.

3. The ventral cord in the body of all Articulates has spinal nerves with two roots, as in the Vertebrates.

4. The dorsal œsophageal ganglion of the Articulates does

not arise on the dorsum ; a morphological distinction between it and the ventral cord does not exist.

5. In Annelids, Arthropods, and Vertebrates, cephalic may be distinguished from body-segments; in all cases the youngest cephalic segment is next the oldest body-segment.

6. In Annelids (Arthropods?), as in Vertebrates, the type of the collective organization is indicated by " evolutio bigemina " (Von Baer).

7. Beneath the nervous system of the Annelids lies a cellular cord (chorda dorsalis?), indicating the axis from which the two muscle-tubes extend round the alimentary canal and central nervous system respectively.

8. Beneath this cellular cord and above the alimentary canal in the Annulates, there lies a vessel in which valves are entirely wanting, and in which the blood flows from before backwards, just as in the aorta of the Vertebrates.

9. The so-called dorsal vessel of the Annelids corresponds to the Vertebrate heart; it lies beneath the alimentary canal; and the blood in it flows from behind forwards. It is the sole vessel which contains valves, and never loses its contractility; and it is always a venous heart, which last is the embryonic type of heart in the Vertebrates.

10. The external gills of the Annelids and Arthropods receive their venous blood, like those of the Vertebrates, direct from the heart.

11. The segmental organs of the Annelids appear on the neural side, close beneath the axial cord and nervous system, exactly as with the segmental organs of the Vertebrates. (Häckel's section of the embryo of an earthworm is entirely incorrect.)

While, therefore, the hypothesis that ventrum and dorsum are morphologically similar (homologous) regions in the Vertebrates and Articulates has only the single morphological fact of the ventral position of the mouth to support it, the view that dorsum and ventrum are not similar in these animals is based upon a whole series of the most important morphological considerations.

Quite apart from the correspondence resulting from this view, in the vascular system, in the urogenital system, and in the typical parts of the nervous system, three arguments appear to me to be preeminently suited definitely to oppose the former hypothesis.

These are:—the proof that " evolutio bigemina " occurs also in the Annelids; the evidence that no distinction exists between the brain and ventral cord in the Articulates; and, lastly, the facts, already mentioned by others, that in Annelids, Arthro-

pods, and Vertebrates the cephalic and body parts of the animal are to be regarded as directly equivalent, because they originate in an absolutely similar manner.

This is not the place to draw the conclusions which naturally follow from the above considerations; for these I must refer the reader to my more complete work, which will appear in the next volume of the 'Arbeiten aus dem zoologisch-zootomischen Institut in Würzburg.'

Würzburg, January 20, 1876.

BIBLIOGRAPHICAL NOTICE.

Catalogue of the Fossil Reptilia of South Africa in the Collection of the British Museum. By Richard Owen, C.B., F.R.S. 4to. London: Printed by Order of the Trustees, 1876.

In this work the Author has completed another of the series of 'Descriptive and Illustrated Catalogues' by which, as in the case of Hunter's 'Physiological Series in the Museum of the College of Surgeons,' he has made available to students and applicable to the advancement of science collections in our Public Museums.

The subject of the present Catalogue, in quarto, illustrated by 70 plates, is a series of fossils from South Africa, now arranged and exhibited in the Geological Department of the British Museum.

It appears that comparatively few of these evidences of the cold-blooded air-breathing Class could be brought within the limits of previously characterized Orders; and they have consequently led to the definition of new ones.

The order *Theriodontia* is characterized as follows:—"Dentition of the carnivorous type; incisors defined by position, and divided from molars by a large laniariform canine on each side of both upper and lower jaws, the lower canine crossing in front of the upper, as in Mammalia" (p. 15). Of this order twenty-two specimens are described, and referred to fourteen species representing ten genera, which are grouped, according to characters of the external nostril, into the families *Binarialia*, *Mononarialia*, and *Tectinarialia*. The type genera of this order are *Lycosaurus*, *Tigrisuchus*, *Cynochampsa*, *Nythosaurus*, *Scaloposaurus*, *Procolophon*, and *Gorgonops*.

The order *Anomodontia* is characterized by:—"Teeth wanting or limited to a single pair, having the form and proportion of tusks, or several and small, but limited to the bony palate and to the inner part of the mandibular alveolar border. The first two families, defined by dental characters, also yield the following ordinal ones, viz.:—a 'foramen parietale;' two external nostrils; tympanic pedicle fixed; vertebræ biconcave; anterior trunk-ribs with a bifurcate proximal end; sacrum of more than two vertebræ; ischio-pubic symphysis continuous" (p. 29).